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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/891,129	06/26/2001	Akira Nishiyama	210313US2SRD	1717

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OBLON SPIVAK MCCLELLAND MAIER & NEUSTADT PC
FOURTH FLOOR
1755 JEFFERSON DAVIS HIGHWAY
ARLINGTON, VA 22202

EXAMINER

MAI, ANH D

ART UNIT	PAPER NUMBER
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2814

DATE MAILED: 07/31/2002

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application N .

09/891,129

Applicant(s)

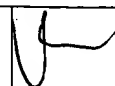
NISHIYAMA ET AL.

Examiner

Anh D. Mai

Art Unit

2814



-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 24 June 2002.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-15 is/are pending in the application.
- 4a) Of the above claim(s) 14 and 15 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-13 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 26 June 2001 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) 3.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

Art Unit: 2814

DETAILED ACTION

1. Applicant's election without traverse of Group I, claims 1-13 in Paper No. 5 is acknowledged.

Drawings

2. Figure 1 and 2s should be designated by a legend such as --Prior Art-- because only that which is old is illustrated. See MPEP § 608.02(g). A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

Specification

3. The lengthy specification has not been checked to the extent necessary to determine the presence of all possible minor errors. Applicant's cooperation is requested in correcting any errors of which applicant may become aware in the specification.
4. The title of the invention is not descriptive. A new title is required that is clearly indicative of the invention to which the claims are directed.

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Art Unit: 2814

5. Claims 3-5, 7 and 9-12 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claims 3-5 recite the limitation "*said* nano-crystal grains" in line 2.

Claim 7 recites: "wherein an oxynitride film is formed **between** said semiconductor substrate and said insulating film". Since the insulating film (133) comprises an oxynitride, therefore, the oxynitride film (133) could not be between itself and the substrate (130). (See Fig. 15).

Claim 9 recites the limitation "*said functional* element" in line 2.

Claims 10 and 11 recite the limitation "*the largest crystal grain*" in lines 3-4.

Claim 12 recites the limitation "*the periphery* of at least one of said nano-crystals" in lines 2-3).

There is insufficient antecedent basis for these limitation in the claim.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in-

(1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effect under this subsection of a national application published under section 122(b) only if the international application designating the United States was published under Article 21(2)(a) of such treaty in the English language; or

(2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that a patent shall not be deemed filed in the United States for the purposes of this subsection based on the filing of an international application filed under the treaty defined in section 351(a).

6. Claims 1-4, 7-11 and 13 are rejected under 35 U.S.C. 102(e) as being clearly anticipated by Wallace et al. (U.S. Patent No. 6,291,867).

With respect to claim 1, Wallace teaches a semiconductor device as claimed including:
a semiconductor substrate (20); and
a circuit element using an insulating film (36) formed in the semiconductor substrate (20), the insulating film (36) containing a silicon compound containing at least one element selected from the group consisting of oxygen and nitrogen, and a metal compound containing a metal other than silicon and at least one element selected from the group consisting of oxygen and nitrogen, nano-crystals being formed in the insulating film. (See Fig. 9).

Product by process limitation:

The expression “the size of said nano-crystals being small enough to permit observation of a polycrystalline ring a diffraction image when an electron beam having a beam diameter of the nanometer order in incident in parallel to said insulating film surface” is taken to be a product by process limitation and is given no patentable weight. A product by process claim directed to the product per se, no matter how actually made, *In re Hirao*, 190 USPQ 15 at 17 (footnote 3). See *In re Fessman*, 180 USPQ 324, 326 (CCPA 1974); *In re Marosi et al.*, 218 USPQ 289, 292 (Fed. Cir. 1983); and particularly *In re Thorpe*, 227 USPQ 964, 966 (Fed. Cir. 1985), all of which make it clear that it is the patentability of the final structure of the product “gleaned” from the process steps, which must be determined in a “product by process” claim, and not the patentability of the process. See also MPEP 2113. Moreover, an old and obvious product

Art Unit: 2814

produced by a new method is not a patentable product, whether claimed in "product by process" claims or not.

Regarding the size of the nano-crystal, since the insulating film (36) of Wallace was subjected to high temperature annealing process to crystallize the film (col. 8, lines 4-14), thus, nano-crystals are inherently formed in the insulating film (36).

With respect to claim 2, the silicon compound of Wallace is a compound selected from the group consisting of a silicon oxide, a silicon nitride and a silicon oxynitride. (col. 3, ll. 10-12).

With respect to claim 3, as best understood by the examiner, the nano-crystal of Wallace are made of the metal compound (Zr, Hf).

With respect to claim 4, as best understood by the examiner, the nano-crystal compound of Wallace is made of an oxide, a nitride or an oxynitride of metal (Zr, Hf), thus, other than silicon.

With respect to claim 7, as best understood by the examiner, the semiconductor device of Wallace further includes an oxynitride film (30) formed between the semiconductor substrate (20) and the insulating film (36). (See Fig. 5, col. 5, ll. 38-49).

With respect to claim 8, the metal other than silicon is at least one of metal selected from the group consisting of Zr, Hf.

With respect to claim 9, as best understood by the examiner, the circuit element of Wallace is a MOSFET, thus, the insulating film (36) is a gate insulating film of the MOSFET.

With respect to claims 10 and 11, since nano-crystals is formed within the insulating film (36) of Wallace, thus, meet the limitation of the claims with respect to the size of the largest nano-crystal.

With respect to claim 11, the size in the thickness direction of the insulating film of the largest nano-crystal grain formed in the insulating film (36) of Wallace appears to be substantially equal to the thickness of the insulating film.

With respect to claim 13, the insulating film (12') of Wallace is a mixed film containing silicon and metal compound (Zr, Hf).

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

7. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Art Unit: 2814

8. Claims 5 and 12 are rejected under 35 U.S.C. 103(a) as being unpatentable over Wallace '867.

With respect to claim 5, Wallace teaches the insulating film (36) is crystallized.

Thus, Wallace is shown to teach all the features of the claim with the exception of disclosing the size of the crystals.

However, since the crystallizing temperature of Wallace is similar to that of the present invention, the nano-crystals grains of the insulating film (36) of Wallace would have a similar diameter as claimed.

With respect to claim 12, Wallace teaches the dielectric layer (36) is formed having graded composition where the ratio of silicon to metal varies as a function to depth in the film, the graded film may be formed that is mainly SiO₂ at the interface. (See col. 6, lines 43-54).

Thus, Wallace is shown to teach all the features of the claim with the exception of disclosing the nano-crystals being positioned at a distance of 0.7 nm from the interface.

However, the graded dielectric layer (36) of Wallace is mainly SiO₂ at the interface of the, thus, the nano-crystal in the insulating film (36) is spaced away from the interface by the thickness of the oxide layer.

Therefore, the position of the nano-crystal in the insulating film (36) being a distance from the interface is an inherent result of the graded formation.

With respect to the limitation “ nano-crystal being positioned within a distance of 0.7 nm from the interface”, the value of 0.7 nm appears to be arbitrary number, because the specification explicitly states: it is difficult to obtain the distance from the interface of the insulating film for

the individual crystals. (page 41, ll. 15-17). The specification further states: if the thickness of the SiO₂ film is not larger than 0.7 nm, the distance from the interface of the mixed film is not larger than 0.7 nm. (page 42, ll. 11-22).

9. Claim 6 is rejected under 35 U.S.C. 103(a) as being unpatentable over Wallace '867 as applied to claim 1 above, and further in view of Hsieh et al. (U.S. Patent No. 4,432,035).

Wallace teaches the dielectric layer may be made substantially thicker than a conventional gate dielectric with equivalent field effect. (See Col. 2, lines 30-47).

Thus, Wallace is shown to teach all the features of the claim with the exception of explicitly disclosing the thickness of the if the insulating layer (36).

However, Hsieh teaches a high dielectric constant and low leakage dielectric material is formed to a thickness that overlaps the claimed range. (See Abstract).

Therefore, it would have been obvious to one having ordinary skill in the art at the time of invention to form the insulating film (36) of Wallace to the thickness as taught by Hsieh to form a high dielectric constant layer for the MOSFET.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Anh D. Mai whose telephone number is (703) 305-0575. The examiner can normally be reached on 8:30AM-5:00PM.

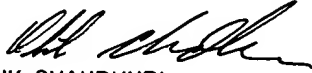
If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Olik Chaudhuri can be reached on (703) 306-2794. The fax phone numbers for the

Art Unit: 2814

organization where this application or proceeding is assigned are (703) 308-7722 for regular communications and (703) 308-7722 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

A.M
July 24, 2002


OLIK CHAUDHURI
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2800